ARTICLE

# Child Abuse and Unintentional Injuries

## *A 10-Year Retrospective*

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**Objective:** To identify differences between hospitalized children injured by child abuse and those with unintentional injuries.

**Design:** Comparative analysis of patients injured by child abuse (n = 1997) with patients injured unintentionally (n = 16 831), newborn to 4 years of age.

**Main Outcome Measures:** Patient characteristics, nature and severity of injury, treatment, length of stay, survival, functional limitations, and disposition at discharge from the hospital.

**Data Source:** Retrospective review of medical records submitted to the National Pediatric Trauma Registry between January 1, 1988, and December 31, 1997.

**Results:** During the 10-year study period, child abuse accounted for 10.6% of all blunt trauma to patients younger than 5 years. Children injured by child abuse were significantly younger (mean, 12.8 vs 25.5 months) and were more likely to have preinjury medical history (53% vs 14.1%) and retinal hemorrhages (27.8% vs 0.06%) than children with unintentional injuries. Abused children were mainly injured by battering (53%) and by shaking (10.3%); unintentionally injured children were hurt mainly by falls (58.4%) and by motor vehicle–related events (37.1%). Abused children were more likely than unintentionally injured children to sustain intracranial injury (42.2% vs 14.1%) and thoracic (12.5% vs 4.5%) and abdominal (11.4% vs 6.8%) injuries; to sustain very severe injuries (22.6% vs 6.3%); to be admitted to the intensive care unit (42.5% vs 26.9%); and to receive Child Protective Services (82.3% vs 8%) and Social Services (72.9% vs 27.6%) intervention. The mean length of stay for children who were abused was significantly longer (9.3 vs 3.8 days) and the survival to discharge from the hospital was significantly worse (87.3% vs 97.4%) than for those unintentionally injured. Among the survivors, children who were abused developed extensive functional limitations more frequently than those unintentionally injured (8.7% vs 2.7%). More than half (56.6%) of the children who were abused were discharged to custodial/foster/Child Protective Services care; most (96.1%) of the children unintentionally injured returned to their homes.

**Conclusions:** Child abuse continues to be a serious cause of mortality and morbidity to infants and toddlers. On average, among children hospitalized for blunt trauma, those injured by abuse sustain more severe injuries, use more medical services, and have worse survival and functional outcome than children with unintentional injuries.

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THE BATTERED child syndrome, a clinical condition in young children who have received physical abuse,[1(p105)] continues to be one of the most significant causes of childhood mortality and disability in the United States.

Of the 22 000 deaths caused by injuries in 1986,[2] 2877 (12.8%) were caused by homicide, the second leading cause of mortality. Six hundred sixty homicide deaths (23%) occurred in children 0 to 4 years of age, representing a rate of 3.6 per 100 000 across sex and race. Of these 660 deaths, 57% were caused by beating and 30% were caused by intentional burning or drowning or shaken baby syndrome.

In a summary[3] by the National Center on Child Abuse and Neglect of the 1986 study of the Incidence of Child Abuse and Neglect, it was estimated that the rate of physical abuse was 4.9 children per 1000 and that 1100 children died as a result of maltreatment, reflecting an incidence rate of 2 maltreatment-related fatalities per 100 000 children.

*See also pages 9 and 11*

However variable these rates are, there is no doubt that child abuse is a most serious cause of head injury,[4-7] severe truncal trauma,[5,8,9] and injuries to the appendicular skeleton.[1,8] Craniocerebral trauma

## PATIENTS AND METHODS

The NPTR is a database that contains information about many aspects of pediatric trauma, its causes, and its consequences. Data are voluntarily contributed to the NPTR by pediatric trauma centers or children's hospitals with pediatric trauma units.

The NPTR collects data on children and adolescents 0 through 19 years old who are admitted to the hospital for an acute injury, including patients who are dead on arrival or die in the emergency department. All injuries are included, with the exception of burns, poisoning, and near drowning.

A trained trauma nurse coordinator at the participating institution completes a data collection form for each admission in accordance with the NPTR operational definitions manual. The forms are sent in batches to the NPTR management center. To guarantee uniformity across institutions, coding for natural and external causes of injury, severity scoring, data management, analyses, and reporting are performed centrally by the staff at the NPTR. This centralization enables staff to collect missing data and perform extensive validity checks. The methods of data collection and quality assurance have been described in detail elsewhere.[24]

The injuries recorded in the NPTR represent a severe subset of all the injuries occurring in children because they include only those injuries that led to hospitalization. Further, since NPTR's participating institutions are hospitals specialized in the treatment of pediatric trauma, the proportion of severe cases reported to the NPTR is higher than that observed in all hospitals.

### SUBJECTS

We extracted from the NPTR the following 2 groups of children injured by blunt trauma and consecutively reported to the registry by more than 70 participating hospitals between January 1, 1988, and December 31, 1997: (1) all cases reported to the NPTR as an established case of child abuse and (2) all cases reported to the NPTR as an established case of unintentional injury.

The distinction between child abuse and unintentional injury was made at the treating hospital and was not questioned. All cases reported as suspected child abuse were excluded.

### SELECTION PROCESS

A group of 2145 child abuse cases were identified; 1997 cases (93.1%) consisted of patients younger than 5 years, the remaining being 5 to 19 years old. A decision was made to exclude children 5 years or older and to select all those younger than 5 years and injured by nonintentional blunt trauma as a comparison group. This process yielded 1997 children in the child abuse group and 16 831 children in the unintentional injury group.

The child abuse group represented 10.6% and the unintentional injury group represented 87.2% of all the blunt trauma to children younger than 5 years, the remaining blunt cases (2.2%) being of undetermined intent.

### MEASURES

The following variables were included in the comparison: sex; age; preinjury medical history; injured body regions; severity of injury; treatment and utilization of resources during hospitalization, including admission to the intensive care unit; surgical intervention; and outcomes.

Severity of injury was measured by the Injury Severity Score (ISS).[25] In conformance with the computation of the ISS, body regions considered in the analysis included the head and the neck, the face, the thorax, the abdomen, the extremities, and the skin.

Outcomes were measured by hospital length of stay, survival to discharge from the hospital, number of functional limitations, and disposition at discharge from acute care.

Functional status was assessed at the time of hospital discharge by rating the child's ability in 9 to 10 functional domains: vision, hearing, speech, self-feeding, bathing, dressing, walking, bowel and bladder control (from 1995 on), cognition, and behavior. Using performance and neurological tests, a clinician rated the performance of the child in each functional area as being either *age appropriate*, *impaired*, or *unable*. In our analyses, the categories of *impaired* and *unable* were combined to reflect any degree of functional limitation. In addition, for each functional limitation, the clinician indicated whether it existed before the current trauma event and, if so, whether it was worsened by the current injury.

Since the functional limitations recorded in the NPTR are detected at the time of discharge from acute care, less obvious and more subtle limitations that may develop or become evident later on are not captured.

### DATA MANAGEMENT AND ANALYSIS

Data analyses were performed using BMDP[26] statistical software. A $\chi^2$ test, *t* test, and multivariate logistic regression analysis were applied. Graphics were produced using the Harvard Graphics 3.0 software package.[27]

is the most common cause of mortality in physically abused children, second only to motor vehicle–related injuries as a cause of traumatic mortality in the pediatric age group.[3,10] A particular form of craniocerebral trauma observed in abused children results from violent shaking of the baby. This type of maltreatment, referred to as the *shaken baby syndrome* (SBS),[11-13] was found to be sufficient cause for severe and often fatal intracranial injuries in absence of external impact.[6,14,15] The SBS was also found to be associated with the presence of retinal hemorrhages[4,6,16-20] not otherwise explained by impact alone.

Risk factors for abuse are family- and child-related. While low family income has been consistently identified as the most important correlate to physical abuse,[21-23] premature birth, chronic illness, and congenital deficiencies or abnormalities are considered to increase the child's vulnerability to maltreatment.[5,22]

The purpose of this study is to determine whether, for children younger than 5 years, there are differences

**Table 1. Patient Characteristics by Group, NPTR, 1988 to 1997***

| | Unintentional Injury, No. (%) | Child Abuse, No. (%) |
|---|---|---|
| Total | 16 831 (100) | 1997 (100) |
| Sex† | | |
| Male | 9991 (59.4) | 1158 (58.0) |
| Female | 6730 (40.0) | 830 (41.6) |
| Age, mo‡ | | |
| <1 | 107 (0.6) | 15 (0.8) |
| 1-12 | 3900 (23.2) | 1238 (62.0) |
| 13-24 | 3391 (20.1) | 371 (18.6) |
| 25-36 | 3802 (22.6) | 236 (11.8) |
| 37-59 | 5631 (33.5) | 137 (6.9) |
| Mean (SD) | 27.5 (16.1) | 12.8 (12.6) |
| Median | 28.0 | 8.0 |
| Medical history‡ | 2366 (14.1) | 1058 (53.0) |

*NPTR indicates National Pediatric Trauma Registry.
†Information not available for 110 children (0.6%) in the unintentional injury group and 9 (0.4%) in the child abuse group.
‡P<.001 by $\chi^2$ test.

between victims of child abuse and those with unintentional injuries, in terms of patient characteristics, severity of injuries, nature of injuries, and outcomes at the time of discharge from acute care. Based on the premise that the physiologic and developmental resources are similar for the same age group, the study hypothesis is that injuries caused by child abuse and unintentional injuries will exhibit distinctive patterns in nature, severity, survival, and functional outcome. The study population consists of patients hospitalized for an acute injury in hospitals participating in the National Pediatric Trauma Registry (NPTR) during a 10-year period.

## RESULTS

### PATIENT CHARACTERISTICS

The sex distribution was similar between the 2 groups, with boys outnumbering girls 60% to 40%. However, abused children were significantly younger, with a mean age of 12.8 months (median, 8.0 months) vs a mean age of 27.5 months (median, 28.0 months) for the unintentionally injured children ($P<.001$). The majority of children (62.7%) in the child abuse group were infants. In fact, nearly one quarter (23.8%) of all infants hospitalized for blunt trauma were victims of child abuse. This proportion decreased to 9.9% in 1-year-olds, 5.8% in 2-year-olds, and 2.4% in 3- to 4-year-olds (**Table 1**).

Children in the child abuse group were more likely than those in the unintentional injury group (53.0% vs 14.1%; $P<.001$) to have a history of medical problems or conditions preceding or concomitant with the acute injury episode (Table 1). The most common observed conditions were prematurity, old fractures in various stages of healing, chronic subdural hematomas, retinal hemorrhages, skin infections related to poor hygiene, and a variety of problems indicative of the chronicity of the maltreatment.

History of prematurity was 7 times more frequent in the child abuse group than in the unintentional injury group (2.2% vs 0.3%; $P<.001$). Information regarding the presence of retinal hemorrhage was systematically collected in the NPTR only from October 1995 on. On examination of this subset of data, retinal hemorrhages were reported in the child abuse group in 27.8% of the cases (159 cases of 571) vs 0.07% of the cases (3 cases of 4568) in the unintentional injury group ($P<.001$). Of these 3 cases, 2 were injured in a fall and 1 was accidentally struck by an object.

### EXTERNAL CAUSES OF INJURY

The children in the unintentional injury group were mainly injured in falls (53.4%) or as motor vehicle occupants or pedestrians (37.1%). Among those in the child abuse group, battering was reported in 53% of the cases and shaking in 10.3% of the cases. The remaining 36.6% of the cases were due to a variety of causes, such as torsion, twisting, suffocation, strangulation, pulling with excessive force, or throwing against a hard surface. Twenty-one children were both physically and sexually abused. In a few cases, the mechanism was suspected to be a combination of shaking and battering.

The place where the injury occurred was significantly different between the 2 groups ($P<.001$). Given the age bracket, most injuries took place at the child's home or at another private home: 54.9% in the unintentional injury group vs 88.4% in the child abuse group. In both groups, injuries at the day care center accounted for a small proportion: 0.9% in the unintentional injury group vs 0.1% in the child abuse group. As expected from the external causes of injury, a large proportion (32.5%) of the children in the unintentional injury group were injured on the road.

### NATURE OF INJURY

To document the nature of the injuries, we analyzed the injury diagnoses as follows. Up to 15 injury diagnoses can be recorded in the NPTR for each case.

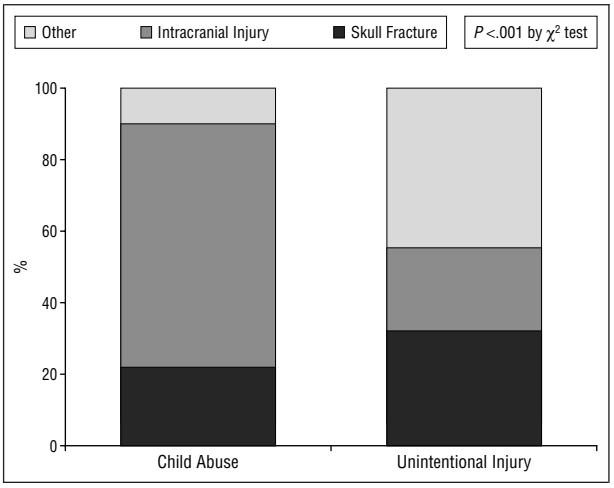
In agreement with the 6 body regions used in the computation of the ISS (head and neck, face, thorax, abdomen, extremities, and external), we classified the children in the following groups: (1) those who sustained injury to the head with or without injury to other body regions (head); (2) those who sustained injury to the face with or without injury to other body regions (face); (3) those who sustained injury to the thorax with or without injury to other body regions (thorax); (4) those who sustained injury to the abdomen with or without injury to other body regions (abdomen); (5) those who sustained injury to the extremities with or without injury to other body regions (extremities); and (6) those who sustained injury to the skin without injury to other body regions (skin). These groups are not mutually exclusive.

Head injury was identified by the presence of 1 or more of the following *International Classification of Disease, Ninth Revision, Clinical Modification*, natural codes: 800-801 (fractures of skull), 803-804 (fractures of skull), and 850-854 (intracranial injury, excluding those with skull fracture).

**Table 2. Nature of Injury by Group, NPTR, 1988 to 1997***

| | Unintentional Injury | | Child Abuse | |
|---|---|---|---|---|
| | No. | %† | No. | %† |
| **Total** | **16 831** | **100** | **1997** | **100** |
| Body regions | | | | |
| Head‡ | 10 079 | 59.9 | 1239 | 62.0 |
| Face‡ | 1119 | 6.6 | 149 | 7.5 |
| Thorax§ | 761 | 4.5 | 250 | 12.5 |
| Abdomen§ | 1137 | 6.8 | 227 | 11.4 |
| Extremities‡ | 4964 | 29.5 | 620 | 31.0 |
| Skin§ | 1447 | 8.6 | 124 | 6.2 |
| Head§ | **10 079** | **100 (59.9)** | **1239** | 100 (**62**) |
| Skull fracture | 3230 | 32.0 (19.2) | 273 | 22.0 (13.7) |
| Intracranial injury | 2367 | 23.5 (14.1) | 843 | 68.0 (42.2) |
| Other | 4482 | 44.5 (26.6) | 123 | 9.9 (6.2) |
| Injury Severity Score§ | | | | |
| 1-9 | 12 772 | 75.9 | 971 | 48.6 |
| 10-19 | 2584 | 15.4 | 521 | 26.1 |
| 20-75 | 1066 | 6.3 | 451 | 22.6 |
| Not available | 409 | 2.4 | 54 | 2.7 |

**NPTR indicates National Pediatric Trauma Registry.*
*†For head injuries, percentages in parentheses represent percentage of total.*
*‡P>.05.*
*§P<.001 by $\chi^2$ test.*




*Type of head injury by group according to the National Pediatric Trauma Registry, 1988 to 1999.*

**Table 3. Estimated Odds Ratio (OR), Adjusted for Age and Sex, and 95% Confidence Intervals (CI) of Victims of Child Abuse Aged 0 to 4 Years, NPTR, 1988 to 1997***

| Variable | OR | 95% CI |
|---|---|---|
| Medical history | | |
| Child abuse | 6.33 | 5.67-7.07 |
| Unintentional injury | 1.00 | |
| Severe ISS (20-75) | | |
| Child abuse | 2.25 | 1.89-2.68 |
| Unintentional injury | 1.00 | |
| Intracranial injury | | |
| Child abuse | 2.38 | 2.09-2.70 |
| Unintentional injury | 1.00 | |
| Thoracic injury | | |
| Child abuse | 1.70 | 1.39-2.08 |
| Unintentional injury | 1.00 | |
| Abdominal injury | | |
| Child abuse | 2.71 | 2.23-3.29 |
| Unintentional injury | 1.00 | |

**NPTR indicates National Pediatric Trauma Registry; ISS, Injury Severity Score.*

The analysis indicated that while a similar proportion of children in the 2 groups sustained injury to the head (≈60%, as expected in this age range), to the face (≈7%), and to the extremities (≈30%), children in the abuse group were significantly more like to sustain injury to the thorax (12.5% vs 4.5%) and abdomen (11.4% vs 6.8%), while those in the unintentional injury group were more likely to sustain injury to the superficial integument (8.6% vs 6.2%) (**Table 2**).

Detailed examination of the type of head injury observed in the 2 groups provided additional insights.

We classified children who sustained head injury into 3 mutually exclusive subsets: (1) those with a single or multiple skull fractures but no intracranial injury; (2) those with intracranial injury with or without skull fractures; and (3) those with concussion or not otherwise specified closed head injury (other).

When compared, children who were abused were almost 3 times more likely to sustain intracranial injury than children in the unintentional injury group (68% vs 23.5%). Among children in the unintentional injury group, concussion and closed head injury were the most frequent occurrence (44.5%) (**Figure** and Table 2).

Overall, 951 children (47.6%) in the child abuse group sustained injuries to multiple body regions vs 6687 (39.7%) in the unintentional injury group ($P<.001$). In the unintentional injury group, almost 90% of the trauma to multiple body regions was accounted for by being injured as motor vehicle occupant or pedestrian.

Children in the child abuse group sustained significantly more severe injuries than those in the unintentional injury group. As measured by the ISS, the injuries inflicted by abuse were extremely severe (ISS, 20-75) in almost 1 in 4 children (22.6%), a rate more than 3 times higher than that (6.3%) observed in children in the unintentional injury group (Table 2). To estimate the association between child abuse and some patient and injury characteristics, we applied a logistic regression model, controlling for sex and age. The outcome variable was whether the patient was a victim of child abuse. Results (**Table 3**) indicate that the odds of child abuse being associated with the variables examined were highest for preinjury medical history (odds ratio [OR], 6.33; 95% confidence interval [CI], 5.67-7.07), followed by the presence of abdominal injury (OR, 2.71; 95% CI, 2.23-3.29), intracranial injury (OR, 2.38; 95% CI, 2.09-2.70), severe ISS (OR, 2.25; 95% CI, 1.89-2.68), and thoracic injury (OR, 1.70; 95% CI, 1.39-2.08).

## DIAGNOSTIC PROCEDURES AND TREATMENT

To determine whether the abused children received an appropriate medical and psychosocial evaluation, we compared the 2 groups in terms of diagnostic procedures per-

**Table 4. Diagnostic Procedures and Treatment by Group, NPTR, 1988 to 1997***

| | Unintentional Injury, No. (%) | Child Abuse, No. (%) |
|---|---|---|
| Total | 16 831 (100) | 1997 (100) |
| CT head† | 6288 (37.4) | 881 (44.1) |
| CT abdomen† | 2504 (14.9) | 252 (12.6) |
| MRI† | 231 (1.4) | 152 (7.6) |
| Skeletal survey† | 165 (1.0) | 281 (14.1) |
| Funduscopy† | 20 (0.1) | 18 (0.9) |
| ICP monitor† | 387 (2.3) | 295 (14.8) |
| Intensive care unit† | 4333 (26.9) | 849 (42.5) |
| Surgical intervention‡ | 4031 (23.9) | 464 (23.2) |
| CPS†§ | 366 (8.0) | 470 (82.3) |
| Social Services†§ | 1260 (27.6) | 416 (72.9) |

**NPTR indicates National Pediatric Trauma Registry; CT, computed tomography; MRI, magnetic resonance imaging; ICP, intracranial pressure; and CPS, Child Protective Services.*
*†P<.001 by $\chi^2$ test.*
*‡P>.05.*
*§Based on a subset of 4568 cases of nonintentional injury and 571 cases of child abuse.*

**Table 5. Outcomes by Group, NPTR, 1988 to 1997***

| | Unintentional Injury, No. (%) | Child Abuse, No. (%) |
|---|---|---|
| **Total** | **16 831 (100)** | **1997 (100)** |
| Length of stay, d,† mean (SD) [median] | 3.8 (8.0) [2.0] | 9.3 (14.1) [5.0] |
| Survival‡ | | |
| Alive | 16 393 (97.4) | 1744 (87.3) |
| Dead | 438 (2.6) | 253 (12.7) |
| Functional limitations‡ | | |
| 0 | 11 295 (68.9) | 1063 (60.9) |
| 1-3 | 4388 (26.8) | 418 (24.0) |
| 4 or more | 448 (2.7) | 152 (8.7) |
| NA | 261 (1.6) | 111 (6.4) |
| Disposition‡ | | |
| Home | 15 761 (96.1) | 624 (35.8) |
| Foster/custodial care/CPS | 205 (1.2) | 988 (56.6) |
| Other medical | 348 (2.1) | 101 (5.8) |
| Other | 79 (0.5) | 31 (1.8) |

**NPTR indicates National Pediatric Trauma Registry; CPS, Child Protective Services; NA, not applicable/not available.*
*†P<.001 by t test.*
*‡P<.001 by $\chi^2$ test.*

formed and Child Protective Services and Social Services intervention (**Table 4**).

The children in the child abuse group were significantly (*P*<.001) more likely to undergo computed tomographic scan to the head (44.1% vs 37.4%), magnetic resonance imaging of any body part (7.6% vs 1.4%), and skeletal survey (14.1% vs 1.0%). Children in the child abuse group were also more likely than those in the unintentional injury group to receive ophthalmoscopic examination of the retina (0.9% vs 0.1%), although the performance of this examination may have been underreported in both groups. Computed tomographic scan of the abdomen was significantly more frequently performed on children in the unintentional injury group (14.9% vs 12.6%), but we did not examine the frequency of abdominal ultrasound and exploratory laparotomy in either group.

Because of the presumed association of retinal hemorrhages and elevated intracranial pressure,[17] possibly caused by other injuries, we compared the use of an intracranial pressure monitor between the 2 groups and found that children in the child abuse group had an intracranial pressure monitor in place more than 6 times more often than those in the unintentional injury group (*P*<.001).

Finally, we analyzed admission to the intensive care unit and frequency of surgical intervention. The rate of surgical intervention was approximately the same between the 2 groups, but children in the child abuse group were more frequently (42.5%) admitted to the intensive care unit than those in the unintentional injury group (26.9%) (*P*<.001).

The information regarding Child Protective Services and Social Services intervention was systematically collected in the NPTR from 1995 on. Based on this subset of data, Child Protective Services intervention was provided for the children in the child abuse group 10 times as frequently (82.3% vs 8.0%) and Social Services 3 times as frequently (72.9% vs 27.6%) as for those in the unintentional injury group (*P*<.001).

## OUTCOMES

On average, the children in the child abuse group stayed in the hospital significantly longer (9.3 days) than those in the unintentional injury group (3.8 days) (*P*<.001). In the hospital, the case fatality rate for the children in the child abuse group was significantly higher than in the unintentional injury group (12.7% vs 2.6%, *P*<.001). In fact, the child abuse group represented 10.6% of all the blunt trauma in this study but accounted for 36.6% of the fatalities (**Table 5**).

We then classified the surviving children in the 3 following subsets, according to the number of functional limitations caused by the current injury and detected at discharge from acute care: (1) 0 limitations; (2) 1 to 3 limitations; and (3) 4 or more limitations.

The above classifications are based on previous research[28-30] that indicated that 1 to 3 limitations represent reduced performance in the activities of daily living, while 4 limitations or more involve neurologic-related performance.

The proportion of children who had no limitations was higher in the unintentional injury group. The proportion who developed 1 to 3 limitations was similar between the 2 groups, but 4 or more limitations were observed in 8.7% of those in the child abuse group, a rate more than 3 times (2.7%) that observed in those in the unintentional injury group (*P*<.001) (Table 5). However, it should be noted that for a substantial number of those in the child abuse group (6.4%), the functional assessment was not available, mainly because of the inability to perform an evaluation at such a young age.

As expected, the disposition at discharge was significantly different between the 2 groups (*P*<.001). Most

children (96.1%) in the unintentional injury group returned to their homes, while more than half (56.6%) of the children in the child abuse group were discharged either to foster/custodial care or in care of Child Protective Services. The percentage of children in the child abuse group who required additional medical intervention (5.8%) inclusive of rehabilitation was more than twice that in the unintentional injury group (2.1%) (Table 5).

## COMMENT

This study indicates that physical maltreatment is still a common and severe event, often resulting in fatal outcome or extensive neurologic compromise. This is despite a plethora of interventions developed over the last 30 years, including legislatively mandated reporting and the establishment in 1974 of the National Center on Child Abuse and Neglect as a mechanism to increase knowledge of the problem and identify steps to prevent it.[5,22,31]

We undertook this project with the expectation that the extensive cohorts available for review would allow us to confirm previous findings and to evaluate specific issues related to child maltreatment.

In the NPTR, physical abuse represented nearly 11% of all blunt trauma to children 0 to 4 years of age, a rate similar to that reported by others[5]; boys outnumbered girls (60% to 40%), as indicated by previous research.[32,33] As expected in this age group, the scene of injury was mainly the child's home or other private dwellings, in both groups. For maltreatment, the other private dwelling was often reported to be the home of a divorced or separated parent whom the child was visiting. From the detailed description provided to the registry about the injury event, it was often surmised that the perpetrator of the abuse was a member of the family or someone associated with the family. The mother's boyfriend was frequently mentioned as the suspected party. Day care centers were reported only infrequently as the place where the abuse occurred (0.1%).

The NPTR recording of the medical history preceding or concomitant with the hospitalization for injury allowed us to examine 2 conditions commonly, and in 1 case controversially, associated with physical abuse: premature birth and retinal hemorrhage. We were able to confirm the association between premature birth and child abuse[21-23]: prematurity was observed in children in the child abuse group 7 times more frequently than in those in the unintentional injury group.

Retinal hemorrhage was exceedingly more frequent in the child abuse group than in the unintentional injury group (27.8% vs 0.07%), an important finding because retinal hemorrhages sometimes have been attributed to elevated intracranial pressure[17] and cardiopulmonary resuscitation.[34] Our study seems to provide additional evidence to previous research[4,6,16-20] that retinal hemorrhages, in absence of documented history of major trauma, such as motor vehicle crashes, should be considered as diagnostic of child abuse.

Severity of injury was greater among the children in the child abuse group, a sober reminder that abusive acts are intended to cause harm. Head injury is a very common occurrence in the very young population; as such, we observed a high (≈60%) and similar rate of head injury in both groups. However, intracranial injury was 3 times more frequent among the maltreated children. This confirms previous findings that, unless the injury is caused by motor vehicle, the presence of intracranial injury in this age group should raise suspicion of abuse.[4,6] Also, injuries to the thorax and abdomen were more frequently observed in the child abuse group, as indicated by other studies.[8,9]

For the abused children, the in-hospital death rate (12.7%) was 5 times higher and the average length of stay (9.3 days) was 2.5 times longer than for those in the unintentional injury group, a strong warning that, in terms of human and societal costs, the child maltreatment epidemic cries for urgent preventive interventions. It should be noted that the extended length of stay of the abused children is associated not only with the severity of injury but also with the amount of time required by the discharge trauma team to find a proper placement for the child to avoid returning the patient to the environment where the abuse first took place.

Finally, although most of the abuse (55%) took place at the child's home, 35% of the children are returned to their homes. Although it has been indicated that this is common and not the most desirable decision (R.M.R., written communication, January 20, 1999), it should be remembered that the abuse might have been caused by a visitor or someone not regularly living with the family, such as a babysitter or a mother's boyfriend.

Since hospitalization for abuse represents only a small fraction of the wide maltreatment spectrum,[35] several limitations of this study should be kept in mind. On one end of the spectrum, extremely severe cases that resulted in death at the scene as well as cases of children injured by other potentially severe means such as burns, poisoning, and near drowning are not included in the NPTR. On the other end, the cases reported to the NPTR are most likely representative of more severe trauma than the trauma observed in community hospitals, emergency departments, and outpatient medical facilities: the NPTR includes only hospitalizations in institutions that specialize in the delivery of advanced pediatric trauma care. Additionally, the injuries were classified as resulting from child abuse or unintentional trauma at the treating centers. The NPTR did not perform an independent investigation nor does it contain data concerning legal findings, if any, associated with the child abuse cases.

## CONCLUSIONS

Marked differences in injury circumstances, characteristics, and outcomes exist between injuries resulting from child abuse and unintentional injuries among children aged 0 to 4 years.

Child abuse is a complex problem that requires immediate intervention to protect the child from further harm.[5] Prompt evaluation in a protective environment, inclusive of hospital inpatient units in the absence of a specialized center for the care of abused children, is essential.[36] Improved education of medical practitioners regarding symptoms and signs of physical abuse[37] and

improved documentation of physical abuse cases[38] are highly recommended.

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